Diagnosis of Epilepsy

서 대 원

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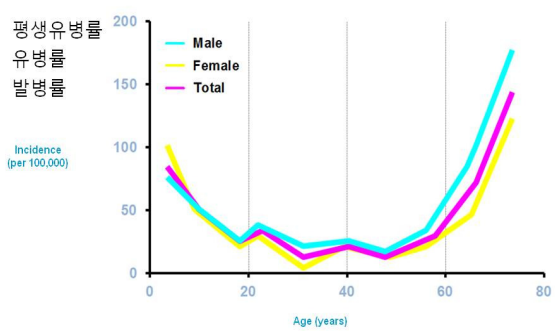
용어

우리말	한자	일본어	영어
경련	痙攣	けいれん(*께이렌*)	Convulsion
발작	発作	ほっさ(*홋싸*)	Seizure
간질	癎疾		Epilepsy
전간	癲癎	てんかん(*뗑깡*)	

Epilepsy

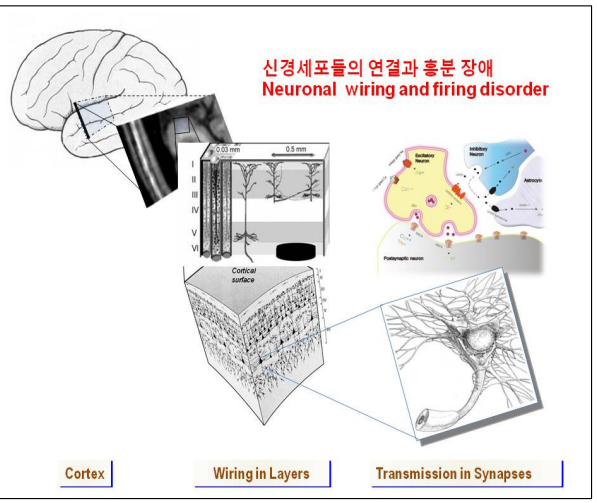
One of the most common serious neurological disorders worldwide with no age, racial, social class, national or geographic boundaries.

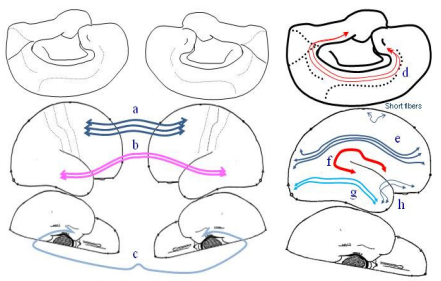


Definition

- **Epilepsy** is
  a common chronic neurological disorder
  characterized by recurrent unprovoked seizures.[1][2]
- The epileptic seizures are
  transient signs and/or symptoms of
  abnormal, excessive or synchronous neuronal activity in the brain.[3]
- The brain disorder is characterized by
  an enduring predisposition to generate epileptic seizures and by
  neurologic, cognitive, psychological, social consequences of this condition.[3]

1. Commission on Epidemiology and Prognosis, ILAE. Epilepsia 1993.
2. Blume W, et al. Glossary of descriptive terminology for ictal semiology: report of the ILAE task force on classification and terminology. Epilepsia 2001.
3. Fisher R, et al. Epileptic seizures and epilepsy: definitions proposed by the ILAE and IBE. Epilepsia 2005.

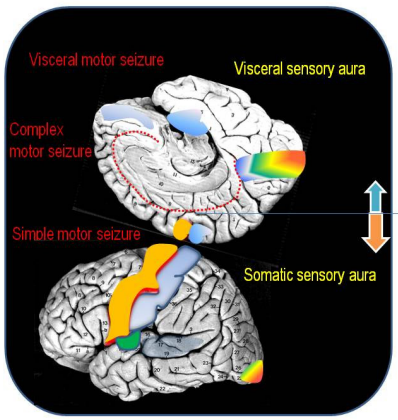




a: corpus callosum
b: ant/post commissure
c: hippocampal commissure

d: cingulum
e: superior longitudinal fasciculus
f: arcuate fasciculus
g: inferior longitudinal fasciculus
h: Uncinate faciculus

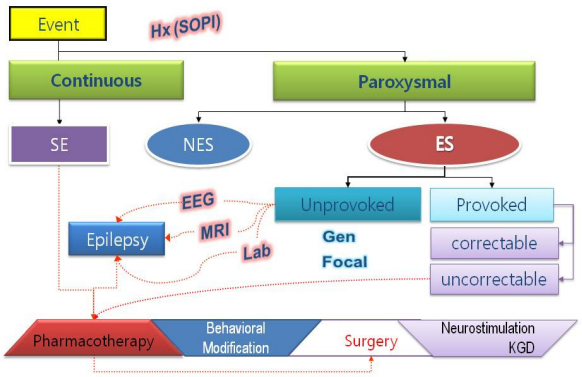
Seizure Types on Epileptogenic Zone

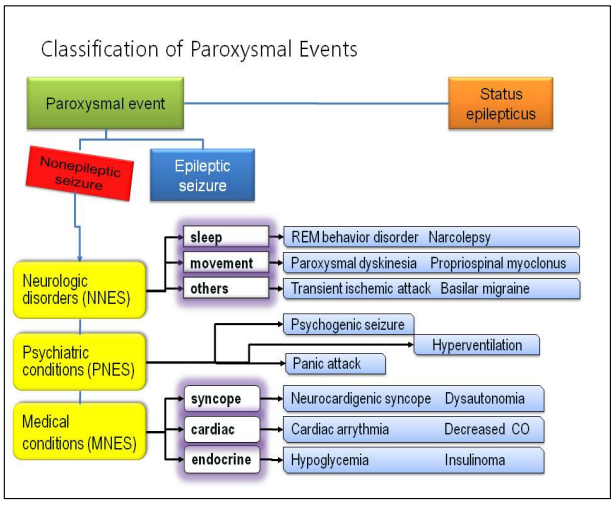


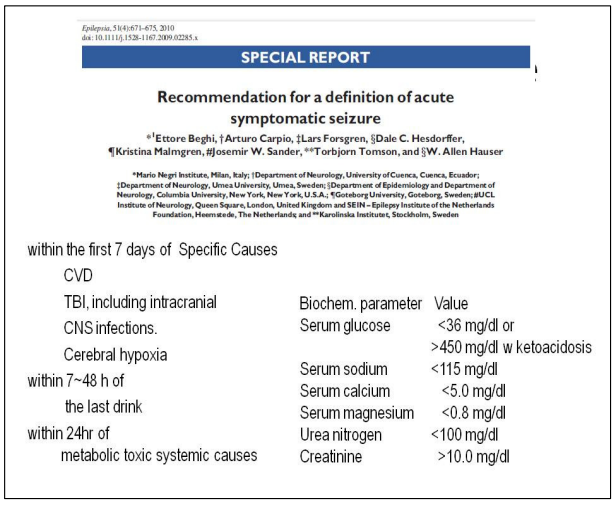
내용

- 소개
- 뇌전증의 진단, 발작의 분류
- 검사
- 증례

Algorithm for Evaluating Spells







Epilepsia, 51(4):671–675, 2010
doi: 10.1111/j.1528-1167.2009.02285.x

SPECIAL REPORT

Recommendation for a definition of acute symptomatic seizure

*†Ettore Beghi, †Arturo Carpio, ‡Lars Forsgren, §Dale C. Hesdorffer, ¶Kristina Malmgren, #Josemir W. Sander, **Torbjorn Tomson, and §W. Allen Hauser

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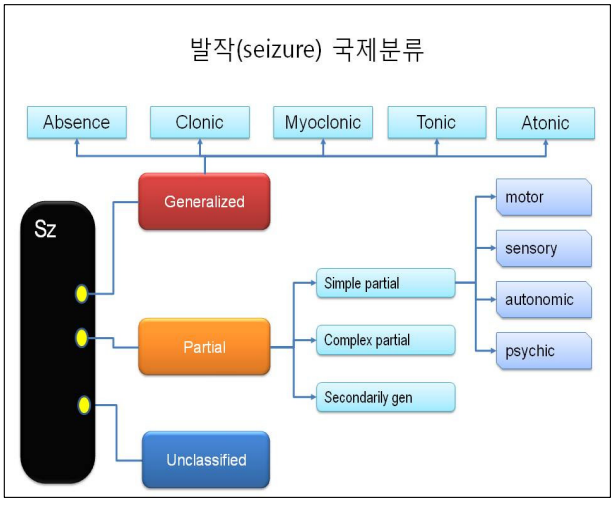
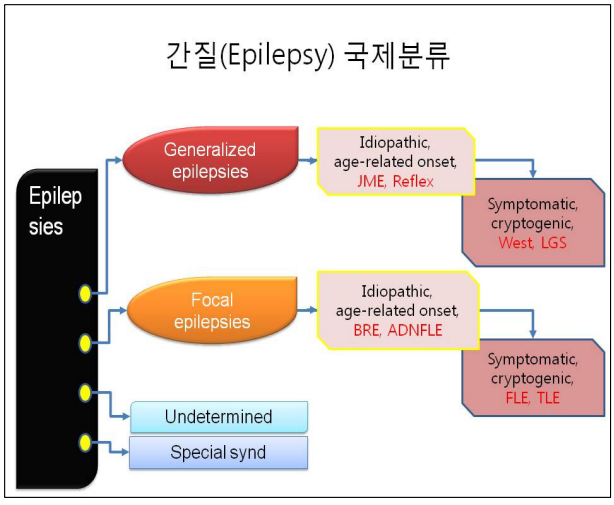
within the first 7 days of Specific Causes
- CVD
- TBI, including intracranial
- CNS infections.
- Cerebral hypoxia

within 7~48 h of
- the last drink

within 24hr of
- metabolic toxic systemic causes

Biochem. parameter	Value
Serum glucose	<36 mg/dl or >450 mg/dl w ketoacidosis
Serum sodium	<115 mg/dl
Serum calcium	<5.0 mg/dl
Serum magnesium	<0.8 mg/dl
Urea nitrogen	<100 mg/dl
Creatinine	>10.0 mg/dl





Epilepsia, 51(4):676–685, 2010
doi: 10.1111/j.1528-1167.2010.02522.x

SPECIAL REPORT

Revised terminology and concepts for organization of seizures and epilepsies: Report of the ILAE Commission on Classification and Terminology, 2005–2009

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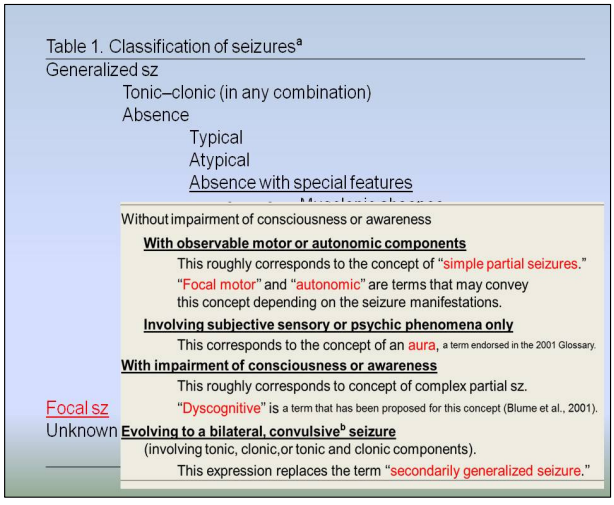


Table 1. Classification of seizures[a]

Generalized sz
- Tonic–clonic (in any combination)
- Absence
  - Typical
  - Atypical
  - Absence with special features

Without impairment of consciousness or awareness

With observable motor or autonomic components
This roughly corresponds to the concept of "simple partial seizures." "Focal motor" and "autonomic" are terms that may convey this concept depending on the seizure manifestations.

Involving subjective sensory or psychic phenomena only
This corresponds to the concept of an aura, a term endorsed in the 2001 Glossary.

With impairment of consciousness or awareness
This roughly corresponds to concept of complex partial sz.
"Dyscognitive" is a term that has been proposed for this concept (Blume et al., 2001).

Focal sz

Unknown **Evolving to a bilateral, convulsive[b] seizure**
(involving tonic, clonic,or tonic and clonic components).
This expression replaces the term "secondarily generalized seizure."

Table 3. Electroclinical syndromes and other epilepsies

Electroclinical syndromes arranged by age at onset[a]

- Neonatal period
- Infancy
- Childhood
- Adolescence – Adult
  - Juvenile absence epilepsy (JAE)
  - Juvenile myoclonic epilepsy (JME)
  - Epilepsy with generalized tonic–clonic seizures alone
  - Progressive myoclonus epilepsies (PME)
  - Autosomal dominant epilepsy with auditory features (ADEAF)
  - Other familial temporal lobe epilepsies
- Less specific age relationship
  - Familial focal epilepsy with variable foci (childhood to adult)
  - Reflex epilepsies

Distinctive constellations

- Mesial temporal lobe epilepsy with hippocampal sclerosis (MTLE with HS)
- Rasmussen syndrome
- Gelastic seizures with hypothalamic hamartoma
- Hemiconvulsion–hemiplegia–epilepsy

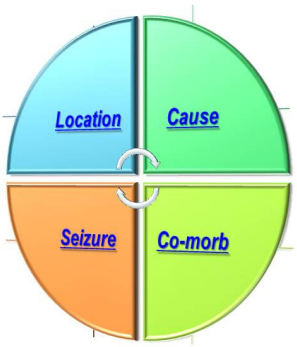
Epilepsies attributed to and organized by structural-metabolic causes

- Malformations of cortical development (hemimegalencephaly, heterotopias, etc.)
- Neurocutaneous syndromes (tuberous sclerosis complex, Sturge-Weber, etc.)
- Tumor
- Infection
- Trauma
- Angioma
- Perinatal insults
- Stroke
- etc

Epilepsies of unknown cause

- Benign neonatal seizures (BNS), Febrile seizures (FS)

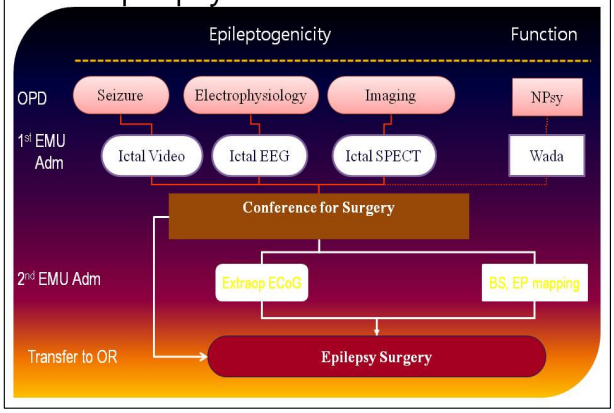
Four Dimensions of Epilepsy Classification



Example of Classification

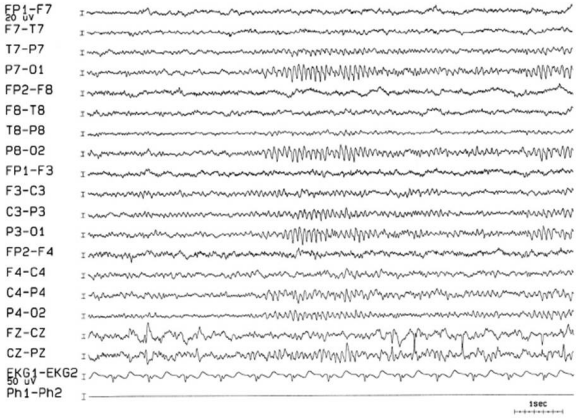
Epileptogenic	*left temporal lobe (mesial temporal)*
Causes	*neoplasm (left mesial temporal DNT)*
Seizures	
semiology	*abdominal aura → automotor seizure*
frequency	*persistent (1 seizure/m)*
triggering	*none*
Conditions	*severe verbal memory problems*

Epilepsy Patient Evaluation



Sphenoidal Maximum INIC ED in MTLE

C/IED in FCD



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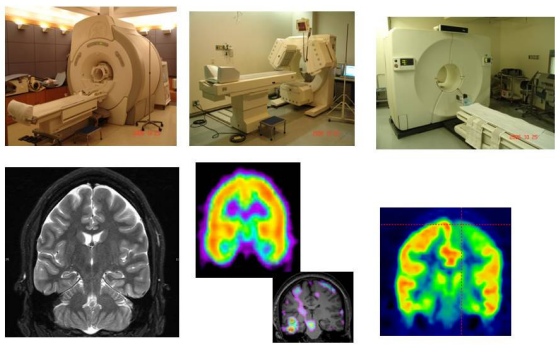
Typical Epiletiform Discharges

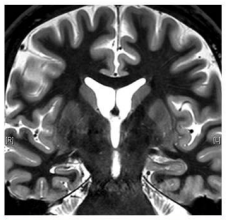
Epilepsy	EEG pattern (interictal)	Epileptic syndrome (Etiology)
Focal	Anterior temporal spike	MTLE
	Reg. Psp (C/IED)	Focal cortical dysplasia
Generalized	Gen. 3Hz SWC	Absence epilepsy
	Gen. >4Hz PSpWC	JME
	Hypsarrhythmia	West syndrome
	Gen. slow SWC	LGS

Neuroimaging

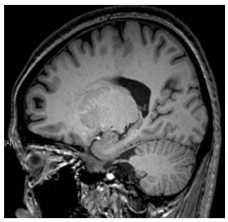
MRI SPECT PET



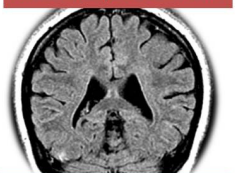
MRI



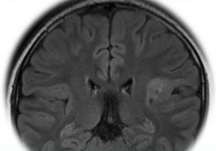
Mesial Temporal Sclerosis



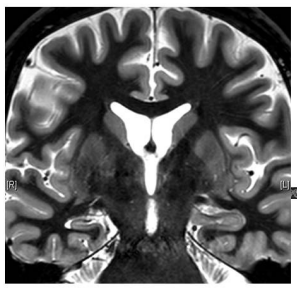
Malformation of Cortical Development

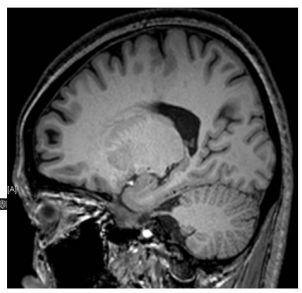


Encephalomalacia



Neoplasm



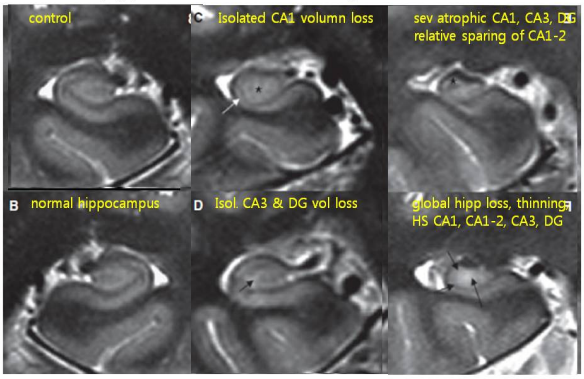


Mesial Temporal Sclerosis

Malformation of Cortical Development

High Resolution MRI

Subfield atrophy pattern in TLE w/wo MTS by high-resolution MRI at 4 Tesla



Epilepsia. 2013 Jul;54(7):1315-29. doi: 10.1111/epi.12220. Epub 2013 May 20.

International consensus classification of hippocampal sclerosis in temporal lobe epilepsy: a Task Force report from the ILAE Commission on Diagnostic Methods.

Blumcke I, Thom M, Aronica E, Armstrong DD, Bartolomei F, Bernasconi A, Bernasconi N, Bien CG, Cendes F, Coras R, Cross JH, Jacques TS, Kahane P, Mathern GW, Miyata H, Moshe SL, Oz B, Ozkara C, Perucca E, Sisodiya S, Wiebe S, Spreafico R.

Author information

Department of Neuropathology, University Hospital Erlangen, Erlangen, Germany.

Abstract

Hippocampal sclerosis (HS) is the most frequent histopathology encountered in patients with drug-resistant temporal lobe epilepsy (TLE). Over the past decades, various attempts have been made to classify specific patterns of hippocampal neuronal cell loss and correlate subtypes with postsurgical outcome. However, no international consensus about definitions and terminology has been achieved. A task force reviewed previous classification schemes and proposes a system based on semiquantitative hippocampal cell loss patterns that can be applied in any histopathology laboratory. Interobserver and intraobserver agreement studies reached consensus to classify three types in anatomically well-preserved hippocampal specimens: HS International League Against Epilepsy (ILAE) type 1 refers always to severe neuronal cell loss and gliosis predominantly in CA1 and CA4 regions, compared to CA1 predominant neuronal cell loss and gliosis (HS ILAE type 2), or CA4 predominant neuronal cell loss and gliosis (HS ILAE type 3). Surgical hippocampus specimens obtained from patients with TLE may also show normal content of neurons with reactive gliosis only (no-HS). HS ILAE type 1 is more often associated with a history of initial precipitating injuries before age 5 years, with early seizure onset, and favorable postsurgical seizure control. CA1 predominant HS ILAE type 2 and CA4 predominant HS ILAE type 3 have been studied less systematically; so far, but some reports point to less favorable outcome, and to differences regarding epilepsy history, including age of seizure onset. The proposed international consensus classification will aid in the characterization of specific clinicopathologic syndromes, and explore variability in imaging and electrophysiology findings, and in postsurgical seizure control.

Epilepsia, 52(1):158–174, 2011
doi: 10.1111/j.1528-1167.2010.02777.x

SPECIAL REPORT

The clinicopathologic spectrum of focal cortical dysplasias: A consensus classification proposed by an ad hoc Task Force of the ILAE Diagnostic Methods Commission[1]

*[2]Ingmar Blümcke, †Maria Thom, ‡Eleonora Aronica, §Dawna D. Armstrong, ¶Harry V. Vinters, #Andre Palmini, **Thomas S. Jacques, ††Giuliano Avanzini, ‡‡A. James Barkovich, §§Giorgio Battaglia, ¶¶Albert Becker, ##Carlos Cepeda, ***[3]Fernando Cendes, †††Nadia Colombo, ‡‡‡Peter Crino, §§§J. Helen Cross, ¶¶¶Olivier Delalande, ###François Dubeau, ****John Duncan, ††††Renzo Guerrini, ‡‡‡‡Philippe Kahane, §§§§Gary Mathern, ¶¶¶¶Imad Najm,

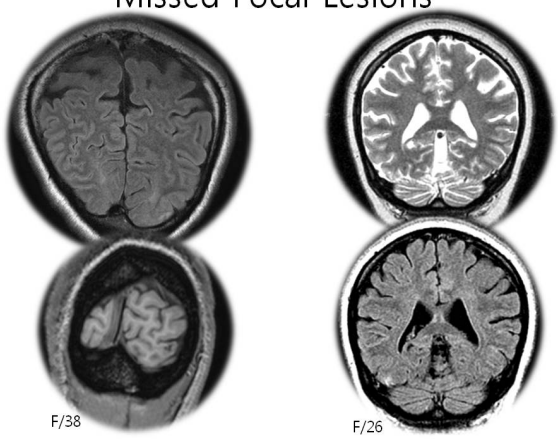
Table 1. The three-tiered ILAE classification system of focal cortical dysplasia (FCD) distinguishes isolated forms (FCD Types I and II) from those associated with another principal lesion (FCD Type III).

FCD Type I (isolated)	Focal cortical dysplasia with abnormal radial cortical lamination (FCD Type Ia)	Focal cortical dysplasia with abnormal tangential cortical lamination (FCD Type Ib)	Focal cortical dysplasia with abnormal radial and tangential cortical lamination (FCD Type Ic)	
FCD Type II (isolated)	Focal cortical dysplasia with dysmorphic neurons (FCD Type IIa)		Focal cortical dysplasia with dysmorphic neurons and balloon cells (FCD Type IIb)	
FCD Type III (associated with principal lesion)	Cortical lamination abnormalities in the temporal lobe associated with hippocampal sclerosis (FCD Type IIIa)	Cortical lamination abnormalities adjacent to a glial or glioneuronal tumor (FCD Type IIIb)	Cortical lamination abnormalities adjacent to vascular malformation (FCD Type IIIc)	Cortical lamination abnormalities adjacent to any other lesion acquired during early life, e.g., trauma, ischemic injury, encephalitis (FCD Type IIId)

FCD Type III (not otherwise specified, NOS): if clinically/radiologically suspected principal lesion is not available for microscopic inspection. Please note that the rare association between FCD Types IIa and IIb with hippocampal sclerosis, tumors, or vascular malformations should not be classified as FCD Type III variant.

Blumcke, et al. Epilepsia, 2011;52(1):158–174.

Missed Focal Lesions

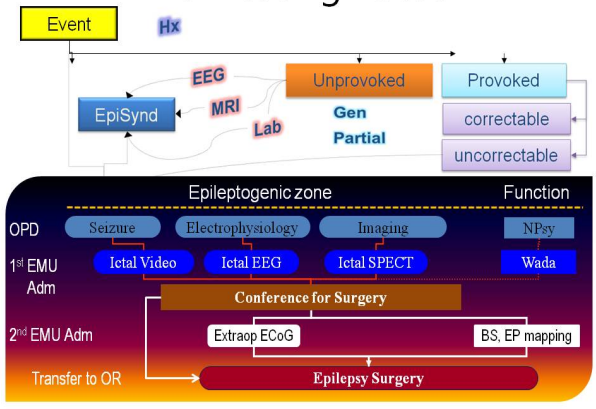


Imaging

Epileptogenic Lesions

Type	Subtype
Malformation	Malformation of cortical development
	Vascular malformation
Foreign tissue lesion	Neoplasm
	Granuloma
	Calcification
	Hemorrhage
Destructive lesion	Demyelination
	Encephalomalacia
	Mesial temporal sclerosis
	Extramesial temporal sclerosis

Delineating Focus



Case 1. 김H신 44/F/ 18ya

87년도, 18yo (고3, 87년도)
갑자기 멍해지면서 의식을 잃고 온몸에 힘이 빠지면서 휘청 간혹 넘어지기도 하며,
주로 왼팔/손에 힘이 빠지면서 잡고 있던 것을 놓침. 1/wk
95년도, 출산 후 2일 전신발작. 1년 지나 산후 우울증 입원 중 1회 더 당시 왼팔에 힘 빠지는 느낌이 들면서 왼팔이 흔들리고 전신발작으로 넘어가는 양상. AED복용시작
07년도, 본원 외래 f/u 왼팔 힘 빠짐 1/wk, 전신발작 1/y
14년도, EMU monitoring

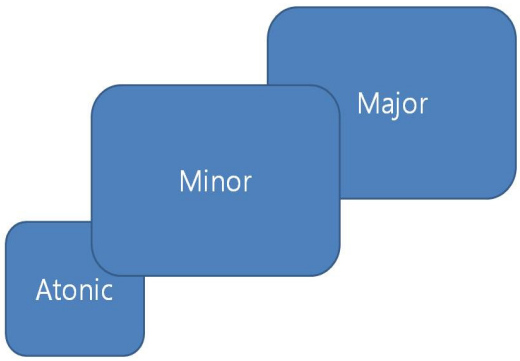
.	OXC	LTG	LEV	VPA
07.10.31	150-300	100-100		
08.03.24	"	150-150		
08.090.3	150-450	"		
09.02.16	"	162.5-162.5		
11.05.27	150-375	"		
12.02.03	225-450	"		
12.090.4	"	100-150		
13.01.28	"	150-150		
13.05.31	"	"	500-500	
13.06.12	"	"	1000-750	
13.06.28	"	"	1500-750	300
13.07.12	"	"	"	300-150
13.09.27	225-150-300	25-150	"	"

Diagnosis

Focal Cryptogenic Epilepsy
Cause : unknown
Seizure
Semiology : astatic seizure
Lt. arm ss aura → Lt. arm clonic → GTC
Frequency : special seizure 1/wk
SGS total 2
Triggering : fatigue, emotional stress
Comorbidity : migraine without aura

Video Clip

Psychogenic Nonepileptic Seizures



문1. Nonepileptic psychogenic seizure의 type으로 tremulous movement가 포함되는 유형은?

가) major motor
나) minor motor
다) negative motor

Case 2. 이H현민 29/F 19ya

2008(중3)	앉아 공부 중 화장실 가려고 일어나는데, 갑자기 왼팔 → 왼다리 저리며, 못움직이며 뻣뻣느낌 10초. 그후 갑자기 소실. 앉았다 일어나면서 발생, 드물게 주저앉기까지 함. 버스, 지하철, 도서관에서 자주 발생, 집 드뭄. 1-3/d
2009.02.14	PED 내원 EMU monitoring. INIC ED: no IC ED: theta to delta in both FC
2009~2011	AED 복용에 뚜렷한 호전 없음
이후	self D/C AED. 증상은 지속
2014.01.10	NR 내원. OXC 300 M. 이후 2-3회/일 → 1회/일
2014.01.22	EMU 재입원

EMU at Ped F/15 10yo

1. Clinical History
   가. Seizure onset: 08.3월경
   나. Semiology : Type I) 왼쪽 팔이 떨리고 다리에 힘이 빠진다.
   dur; 10-20sec post ictal Sx.: none frequency: 1-2/dat
   다. Past medical history : none
   라. AED before epilepsy monitoring unit admission: none
2. Video EEG monitoring Result
   가. Days of monitoring : 2 days
   나. Description and number (2회)
   (1) Sz #1.2: numbness of Lt extrimity
   →clonic sz of Lt arm (sensory aura→Lt side motor seizure)
   EEG: theta to delta in both frontocentral area
   다. 상세기술 (including lateralizing signs) (1) Lt side clonic seizure
   라. Interictal spikes total = none
   마. Features of ictal EEG (1) Lateralized to none (2) Regionalized to FC
3. PLAN oxcarb 300mg bid opd f/u

PED NEURO ooo/ooo

EMU at NR F/20 10yo

Monitoring 20140122~20140124 Electrodes: Scalp FT 10-10
1.Video EEG monitoring Result
-Interictal abnl: none
-Clinical events (5회)
(1) Descripyion -S01~05: 자리에서 일어난 17초~33초 후
→왼팔(다릴) 저린느낌→힘빠짐 →왼손꼬임
(2) Ictal EEG -S01-05: no EEG change
2. Diagnosis: r/o partial seizure << r/o Paroxysmal nonkinesigenic dysknesia
3. Plan

AEDs:	입원 전	퇴원시
Oxcarbazepine	300mg(M)	
Carbamazepine	D/C	300mg(M)

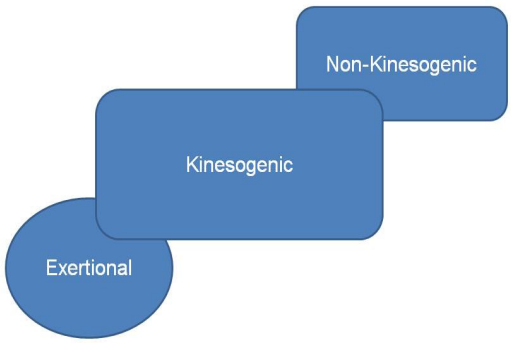
황경진/서대원

AED History

AED	OXC	LTG	LEV	
09.02.27	600-600			
09.03.20	450-450			
09.05.28	600-600			
09.06.18	"	37.5- 37.5		
09.07.31	"	87.5- 87.5		
09.10.30	"	100 - 100		
10.01.08	"	137.5- 137.5		
10.02.19	"	162.5- 162.5		
10.04.23	"	187.5- 187.5		
10.05.24	450-450	200 - 200		
10.06.25	300-300	"		
10.07.23	"		500 - 500	
10.10.07	"		1000 -1000	
11.04.08	"		"	- 마지막 PED 처방일
14.01.10	300 M			

Video Clip

Paroxysmal Dyskinesias

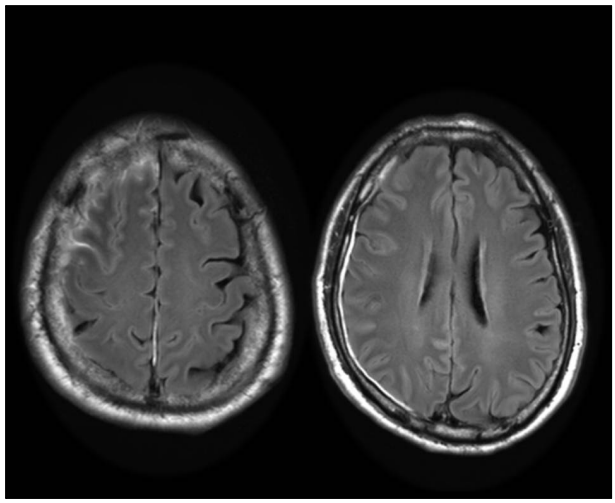


문2. Paroxysmal dyskinesia로 epileptic cause로 보이는 것은?

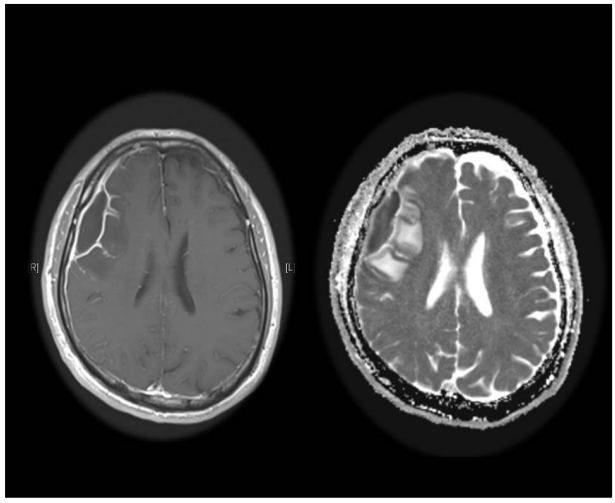
가) Kinesogenic choreoathetosis
나) Non-kinesogenic dyskinesia
다) Exertional induced dyskinesia
라) Hypnic dyskinesia

Case 3. 박M환 M/59

2013.12.12
NR Ha 진료 중 발작.
눈앞 흔들거리는 어지럼→고개좌측→온몸뻣뻣. 1분. 서서히깸.
ER EEG: WNL,
MRI: R.frontal cortical nodular lesion r/o glioma f/u MRI 3m
2013.12.20
NR Ep ■ 진단 Symptomatic focal epilepsy
FTL in rt. SFG r/o tumor
Aura → Lt. versive seizure → GS: SGS once
Rt. hemicranial ha, r/o ha ass. with medical illness
■ 계획 NS 협진, Levetiracetam 500mg bid 35일
NR Ha ■ 계획 [투약] ◈1 Propranolol 40mg 0.5T 2P 35일
◈1 Flunarizine 5mg 1C 2P 35일
[검사] C-spine AP/lat/ob, TCD, Routine【비급여】



2013.12.24 NS
■ 진단 Benign neoplasm of brain, supratentorial,
Acute gastric ulcer without haemorrhage or perforation
■ 계획 [투약] Utracet(R)ER 650mg/75mg 1T 2P 30일
Afloqualone 20mg 1T 2P 30일
Rabeprazole 10mg 1T M 30일
[검사] 3달후 MRI (PRE- & POST-CONT) + Diff + Perf (비급여)
→ 2013.12 진단시 급여 적용. 다음 급여 2014/12, 15, 17, 19 급여 적용후 종료
2013.12.30 ER
두통에 대해 NR, NS OPD f/u 하며 약 복용중. 호전 없는 상태로 지냄.
내원 1일전 일상생활 도중 nausea, vomiting 발생. 두통 이전과 동일.
전일 점심때부터 금일 오전까지 vomiting 4차례, nausea 지속되어 ER.
화장실갈때 Lt. side tilting tendency 있어 ER visit
Rt.Frontal convex 의 fluid collection 에 대하여 NS contact



Epilepsia, 51(4):671–675, 2010
doi: 10.1111/j.1528-1167.2009.02285.x

SPECIAL REPORT

Recommendation for a definition of acute symptomatic seizure

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within the first 7 days of
Specific Causes
CVD;
TBI, including intracranial;
CNS infections.
Cerebral hypoxia

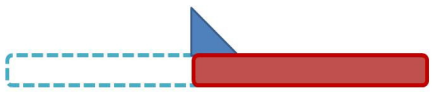
Operatoinally
within 7~48 h of the last drink
within 24hr metabolic toxic systemic causes

Proposed cutoff values for acute symptomatic seizures in common metabolic disorders

Biochemical parameter	Value
Serum glucose	<36 mg/dl (2.0 mM) or >450 mg/dl (25 mM) ass. with ketoacidosis (whether or not there is long-standing diabetes)
Serum sodium	<115 mg/dl (<5 mM)
Serum calcium	<5.0 mg/dl (<1.2 mM)
Serum magnesium	<0.8 mg/dl (<0.3 mM)
Urea nitrogen	<100 mg/dl (>35.7 mM)
Creatinine	>10.0 mg/dl (>884 lM)

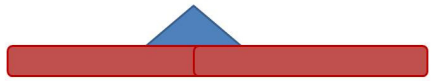
Acute symptomatic seizure

stroke
trauma
infection



Seizure

stroke
trauma
infection



sinus thrombosis, Rt TO lobe infarction
delayed SDH
empyema, abscess

문3. Acute symptomatic seizure인 것은?

가) 발작 직후 serum-Na 121 mg/dl
나) ACA infarction 후 14일째 발작
다) meningitis 후 8일째 발작
라) 금주 후 36시간째 발작

Case 4. 이Y지 32/F 5YA

1. History

2007.10.18 캐나다 토론토 어학연수 중 김치 볶음밥해 프라이팬 들고가다 갑자기 멍해지며 정면응시하고 불러도 대답없고 혼자서 말하는 모습. 훈동에서 회복후 왼손이 아파서 보니까 화상입음
2007.11. 한강성심병원 GS 왼손 화상 피부이식위해 입원.
MRI: L pons, R MB, B cbll, L thal, L GP, R hippo, R amyg lesions
Szs: 갑자기 정면 주시하다 쩝쩝. 오른손 만지작.
2008.04.01 본원 NS 입원. 뇌병변 r/o multifocal glioma로
navigation-guided biopsy. Path: no tumor cells.
그후 CPS (1~2/월) 발생. AED polytherapy로도 발작 지속됨.
2012.08.07 본원 NR 거쳐 presurgical evaluation 위해서 EMU 입원.

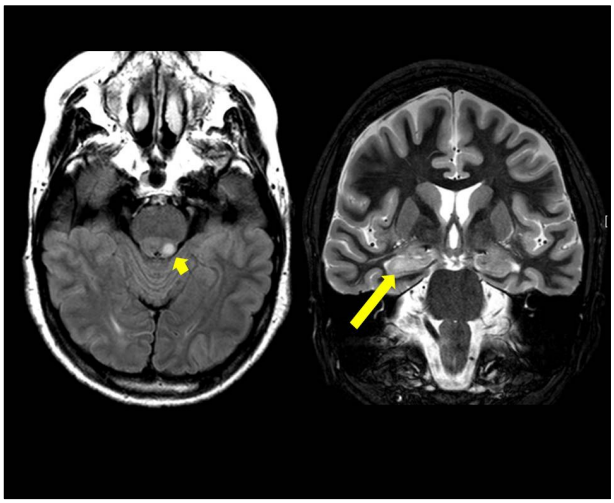
2. Semiology

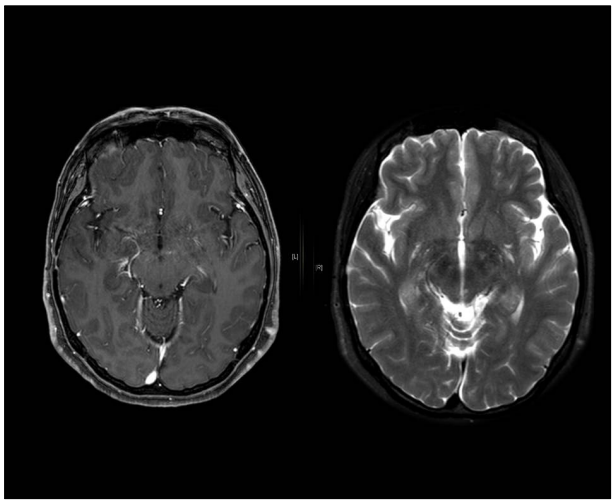
Abd or vertig aura → automotor seizure, Rt hemi; SPS 1-2/w, CPS 1-2/m

3. AED before EMU admission

	CBZ	TPM	LEV	PGB	CBZM
2008.08.12	500-500				
2012.07.17	500-500	200-200	1500-1500	75-75	5-5

Video-EEG monitoring results (201200807~20120809)
INIC ED: Sp, 1-2/2-3min, T8(100.0%)
IC events (11회)
nausea(2) → lip smacking(1,7,9,6.8) → R EB dev(3,10,11)→ L fumbling (4,5)
Ictal EEG Rt temporal onset (10/11), No EEG change (1/11)
Neuroimaging
B-MRI (2012-08-07): R hippocampomegaly Multifocal infiltrative lesions
SPECT(2012-08-09; #11, 40/102sec; injection시 R EB dev, B temp rhythm): Hyperperfusion in the right temporal cortex
PET (2012/10/10) : Hypometabolism in R DL frontal and ant to mid temp
Epilepsy classification: Right temporal lobe epilepsy, symptomatic
Seizures: abdominal aura → automotor seizure
Cause: Rt hippo. lesion R/O CNS lymphoma, R/O NMO, R/O vasculitis
Related medical conditions: none
Plan CNS lymphoma, NMO 등의 감별필요
right TLE에 대한 수술적 치료도 고려함.
AED는 CBZ 500mg bid → OXC 750mg bid로 교체함.
전임의 김지영/ 교수 서대원





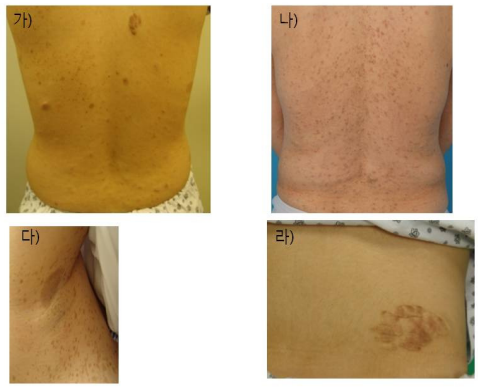
NF1
café-au-lait spots, inguinal/axillary freckling, neurofibromas.

• Diagnosed by two of the following C/F
- ≥ 6 café-au-lait spots (>1.5cm in adults)
- ≥ 2 neurofibromas of any type or plexiform
- Freckling under the arms or in the groin
- ≥ 2 Lisch nodules (iris hamartomas)
- optic nerve tumor (glioma)
- osseous lesion (sphenoid dysplasia)
- relative with NF1 by the above criteria
• Additional but not diagnostic features:
- Precocious puberty or delayed sexual developm
- learning disabilities in reading, spelling or math
- Growth
- Macrocephaly
- Scoliosis
- Hypertension
- Epilepsy

TSC
Adenoma sebaceum, shagreen patch, hypomelanotic macules
Major Features
Facial angiofibromas or forehead plaque
Non-traumatic ungual or periungual fibroma
Hypomelanotic macules (≥ 3)
Shagreen patch (connective tissue nevus)
Multiple retinal nodular hamartomas
Cortical tuber, Subependymal nodule, Subependymal giant cell astrocytoma
Cardiac rhabdomyoma, single or multiple
Lymphangiomyomatosis
Renal angiomyolipoma

Minor Features
"Confetti" skin lesions
Retinal achromic patch, Multiple randomly distributed pits in dental enamel, Gingival fibromas,
Cerebral white matter migration lines
Hamartomatous rectal polyps, Bone cysts, Non-renal hamartoma, Multiple renal cysts

문 4. TSC를 의심할 수 있는 피부병변은?



Summary